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# Learnquest: Helping Engineering Students Learn, Practice, and Grow

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**ABSTRACT:**

In modern education, especially in technical fields like engineering, students often struggle to find consolidated resources for semester-wise practicals, quizzes, and conceptual understanding. LearnQuest is a centralized web-based platform designed to provide engineering students with organized access to semester-specific practicals, programming quizzes, and educational video lectures. The system aims to bridge the gap between scattered content and structured academic preparation. Developed using modern web technologies, the platform enhances student engagement, supports autonomous learning, and assists faculty in content delivery. This paper presents the system's design, features, and the observed impact during preliminary testing.

Keywords: Engineering Education, Web Development, E-learning, Programming Quizzes, Centralized Learning Platform

## 1. Introduction

Today's engineering students rely heavily on online resources. However, accessing subject-wise practicals, verified quizzes, and concise video lectures remains a challenge due to unorganized and scattered sources [1]-[2]. LearnQuest addresses this issue by providing a unified platform where engineering students can browse semester-wise content, take quizzes, and access curated video lectures, all under one roof. In recent years, the field of education has witnessed a massive shift towards digital transformation. With the advent of technology, there is a growing demand for platforms that make learning more accessible [8], interactive, and centralized. For engineering students in particular, the academic journey spans across multiple semesters with a vast syllabus, numerous practical experiments, and ever-evolving technological trends [10]. However, students often face challenges in accessing semester-specific content, organizing practical files, preparing for programming tests, and creating professional resumes all of which are essential components of both academic success and career readiness.

Furthermore, LearnQuest is designed with a student-first approach keeping the user interface simple [7], mobile-friendly, and resource-rich. By organizing content in a structured manner and combining it with modern web technologies, the platform ensures that students from any semester or engineering branch can access what they need quickly and efficiently. The addition of a chatbot also makes the user experience smoother by answering frequently asked questions and guiding students through the platform's features. LearnQuest addresses real-world academic challenges with a practical, user-friendly solution. It is a step toward smarter education, providing the right tools at the right time all within a single, centralized digital space. The evolution of digital technology has significantly reshaped the landscape of education worldwide. With the advent of e-learning platforms, video lectures [3], and AI-powered tools, students today have more access to knowledge than ever before. However, the effectiveness of these platforms largely depends on how well they are curated, structured, and tailored to specific learner needs. In the case of engineering education particularly in developing countries students often face systemic challenges such as inadequate academic resources, outdated teaching methodologies, and a lack of guidance in career development. Engineering students are typically required to manage extensive syllabi across various core and elective subjects, practical lab work, and additional training in programming, aptitude, and soft skills. While there are many independent sources online (e.g., NPTEL, Coursera, GeeksforGeeks, etc.), these platforms often lack personalized structure, local academic alignment (like university-specific practicals), and a seamless interface that integrates both academic and career resources in one place. As a result, students are left to search for fragmented materials across multiple websites, leading to increased cognitive load and reduced study efficiency. In response to these challenges, this research introduces LearnQuest, an integrated web-based educational platform designed to centralize and streamline access to semester-wise academic content, practical files, resume-building resources, programming quizzes, curated courses, video lectures, and a conversational AI chatbot. The goal is not only to support students in completing their curriculum but also to help them build job-ready skills and confidence in applying them in real-world settings [17].

LearnQuest's design philosophy is rooted in learner-centric pedagogy, combining elements of constructivist learning (where learners build new knowledge based on their experiences) with connectivist theory (which emphasizes the role of social and technological networks in learning). The platform leverages a modular architecture that allows scalability, real-time content updates, and integration with third-party tools such as video APIs, quiz engines, and AI-based assistants. The project also acknowledges the increasing need for digital literacy, portfolio development, and soft skill enhancement among engineering graduates. In light of recent surveys conducted by industry bodies such as NASSCOM and AICTE, it is evident that over 60% of engineering graduates in India struggle with employability due to poor access to quality content and career support services. LearnQuest aims to bridge this gap by offering a multi-faceted, low-cost, and accessible learning ecosystem for students across institutions. This paper outlines the system architecture, design methodology, implementation tools, and feature set of LearnQuest, followed by a discussion on its impact, scalability, and potential role in redefining digital education for engineering disciplines.

## 2. Literature Review

The growing integration of digital technologies in education has led to the emergence of numerous e-learning platforms aimed at facilitating student engagement, personalized learning, and academic performance. Over the past decade, platforms such as NPTEL, Coursera, edX, Khan Academy, and GeeksforGeeks have made significant contributions to online education by offering high-quality video lectures, programming tutorials, and certification courses. However, the effectiveness of these platforms often varies depending on the structure, accessibility, and relevance of their content to institutional syllabi, particularly in the context of undergraduate engineering education. Several studies have examined the efficacy of digital platforms in engineering education. According to Sharma et al. (2021), while MOOCs (Massive Open Online Courses) provide flexible and self-paced learning environments, they often lack alignment with the semester-based curricula followed in most Indian universities. Similarly, Singh and Chauhan (2020) argue that the absence of localized content such as university-specific practical files and lab manuals limits the practical applicability of many global platforms for Indian engineering students. Moreover [5]-[9], while platforms like Unacademy and Byju's have gained popularity in the school and competitive exam sectors, their offerings in higher technical education remain limited in scope and personalization. These platforms typically focus on exam preparation rather than holistic academic development, thereby neglecting essential components such as resume building, practical assessments, and soft skill training. On the technological front, advancements in Artificial Intelligence (AI) and Natural Language Processing (NLP) have enabled the creation of intelligent tutoring systems and educational chatbots. Research by Chatterjee and Bhattacharya (2022) highlights the potential of AI-powered chatbots in improving student engagement, doubt clearance, and 24/7 availability of academic support. However, the deployment of such systems in student-built, cost-effective platforms remains underexplored.

The theory of connectivism further extends the conversation by offering a framework more suited to the realities of digital learning. Proposed by George Siemens, connectivism argues that knowledge resides not only within the individual but also in the network of connections between individuals, technologies, and data sources. In such an environment, the capacity to access and apply information becomes more valuable than the mere accumulation of facts. Educational platforms that aggregate a variety of resources such as study materials, video lectures, quizzes, and project repositories thus reflect a connectivist philosophy, wherein learning is seen as an ongoing process of building and navigating networks of knowledge. Parallel to these models is the growing recognition of cognitive load theory, developed by Sweller, which addresses how information should be presented to optimize learning [18]-[20]. This theory posits that learners have a finite capacity for processing new information, and instructional design must aim to reduce extraneous cognitive load while enhancing essential processing. Within educational platforms, the organization of materials, clarity of interface, and progression of content directly influence cognitive efficiency. When digital environments are intuitively structured offering semester-wise categorization, clean navigation, and multimodal content delivery they can significantly improve learning outcomes by aligning with cognitive processing capabilities. Situated learning theory, advanced by Lave and Wenger, presents another critical lens through which educational design is evaluated. This theory argues that learning is most effective when embedded in authentic activities that reflect real-world practices. The inclusion of resume building, real-time projects, and career-oriented tools within educational platforms serves not only functional purposes but also aligns pedagogically with this theory by enabling students to learn in context. Learning thus becomes a socially situated act, preparing learners to participate meaningfully in academic and professional communities.

## 3. Method

The methodological foundation of this study is rooted in the principles of design-based research (DBR), an approach widely used in educational research to explore the development, implementation, and iterative refinement of learning environments. Design-based research is particularly suited to complex educational interventions such as the creation of a digital learning platform, as it integrates theory with practice while maintaining a reflective and evolving orientation. DBR does not aim to isolate variables in controlled settings, but rather to generate context-sensitive, theory-informed solutions to real-world educational challenges. The conception of the LearnQuest platform is informed by a constructivist paradigm, wherein learning is understood as an active, student-driven process. The methodology therefore prioritizes learner engagement, contextualization of knowledge, and scaffolding through a structured interface. The design is also framed by user-centered instructional design models, most notably the ADDIE model (Analysis, Design, Development, Implementation, Evaluation), which serves as a guiding framework for aligning learning outcomes with platform features. Each stage of this model is theoretically informed by learning science analysis through learner needs theory, design through cognitive load considerations, development through multimedia learning principles, and evaluation through metacognitive reflection. From an epistemological standpoint, the methodology aligns with interpretivism, which assumes that knowledge is constructed through interaction, context, and interpretation. The aim of the platform is not merely to deliver content but to co-create knowledge environments where learners engage with resources in meaningful, personalized ways [19]. This ontological commitment positions learners not as passive recipients but as agents in the construction of their academic and professional identities. Research Design: Constructivist Framework for Platform Development

### *3.1 Data Collection: Mixed-Methods Approach*

In terms of data collection, the study employs a mixed-methods approach, combining both qualitative and quantitative techniques to capture the complexity of learning experiences within digital environments. This approach allows for a comprehensive understanding of the effectiveness and impact of LearnQuest in supporting engineering education, in line with the principles of action research. Quantitative Data: The quantitative aspect of the methodology involves the collection of numerical data that tracks student progress, engagement, and performance across a range of metrics. These include: Quiz and assessment scores to measure students' mastery of subject matter. Platform usage statistics, such as time spent on specific resources, frequency of chatbot interactions, and completion rates for modules and practical assignments [7]. Learner performance trends, monitored over time to identify patterns of progress or areas requiring additional support. The quantitative data collection follows learning analytics theory, which emphasizes the use of real-time data to personalize and adapt learning experiences. The data collected through quizzes and other assessments will be analyzed to

determine whether students achieve desired learning outcomes, thereby evaluating the effectiveness of instructional design and content delivery on the platform. This method is particularly influenced by Cognitive Load Theory (Sweller, 1988), which suggests that students' cognitive capacities must be considered when presenting new information, and data can provide insights into how much cognitive load students are experiencing.

### *3.2 Evaluation: Formative and Summative Assessment*

The methodology also involves a two-pronged evaluation approach, incorporating both formative and summative assessment strategies. These evaluation methods are based on a blend of assessment for learning (formative) and assessment of learning (summative), both of which serve different yet complementary roles in understanding the platform's impact.

### *3.3 Formative Evaluation: Formative assessment takes place throughout the development and use of the platform.*

It focuses on real-time feedback and continuous adjustment. This includes gathering data on student engagement, performance on quizzes, and interactions with the chatbot. By utilizing real-time data and feedback loops, the platform can be continuously refined to ensure that it supports student learning and engagement [4]. Formative evaluation thus aligns with constructivist principles, as it emphasizes ongoing support and scaffolded learning. Moreover, learner reflection will be a key component of formative evaluation. Students will be encouraged to regularly reflect on their learning progress, which not only supports metacognition but also contributes to the self-regulated learning process (Zimmerman, 1990). These reflective practices provide a mechanism for understanding students' internal learning processes and further refine the platform's content and structure.

### *3.4 Iterative Feedback and Adaptation*

As the final piece of the methodological framework, iterative adaptation is central to both the development of the platform and the ongoing evaluation. The feedback gathered from both quantitative and qualitative data will feed directly into the platform's ongoing development, ensuring that LearnQuest remains responsive to the needs and experiences of students [6]. This dynamic, evolving approach mirrors developmental evaluation theory, which emphasizes flexibility and responsiveness in educational innovations. In summary, the methodology for evaluating LearnQuest is grounded in both action research and learning science. It emphasizes a holistic, learner- centered approach that combines quantitative performance tracking with qualitative insights into learner experience. The iterative, theory-driven nature of this methodology ensures that LearnQuest evolves to meet the needs of students, guided by pedagogical theory and a commitment to continuous improvement.

## 4. Findings

The findings of this study emerge from a combination of both quantitative and qualitative data, analyzed through the lens of learning theories and educational frameworks. The data reflect the impact of the LearnQuest platform on students' academic performance, engagement, motivation, and skill development in engineering education. These findings are not merely descriptive; they provide deeper theoretical insights into the efficacy of the platform in fostering self-regulated learning, promoting knowledge construction, and enhancing career readiness.

### *4.1 Engagement and Usage Patterns*

The platform's quantitative data, including user engagement statistics such as time spent on various resources (video lectures, quizzes, and practicals), interaction with the AI-driven chatbot, and completion rates, indicate a high level of engagement among students.

### *4.2 Impact on Learning Outcomes*

Regarding academic performance, the data suggest significant improvement in students' mastery of key engineering concepts, particularly in technical subjects such as programming, circuit design, and mathematics. The improvement in quiz scores, project submissions, and practical exercises supports the view that interactive and feedback-driven platforms enhance cognitive engagement and deep learning (Anderson & Krathwohl, 2001).The incorporation of formative assessments, including quizzes and self-assessment tools, allowed students to track their progress, providing a clear view of their strengths and areas for improvement. This approach not only aligns with formative learning theory (Black & Wiliam, 1998), but also with the concept of self-regulated learning (Zimmerman, 1990), where learners actively monitor their learning and adjust strategies accordingly. This iterative process of self-reflection and feedback suggests that LearnQuest fosters metacognitive skills, which are essential for lifelong learning and professional development. Notably [11]-[13], students reported increased confidence in their technical abilities, particularly in areas that were previously challenging. This is consistent with the principles of scaffolding in learning theory, where external support leads to greater learner autonomy as the learner internalizes the knowledge and begins to solve problems independently.

### *4.3 User Experience and Perceived Value*

Qualitative data gathered from interviews, surveys, and open-ended responses revealed that students valued the personalization and flexibility that LearnQuest offers. In alignment with andragogy (Knowles, 1980), students appreciated the ability to choose their learning path and the freedom to access resources according to their individual needs and interests. This reflects the core tenets of adult learning theory, which emphasizes self-directed learning

and the need for learning to be relevant and applicable. Many students highlighted the relevance of real-world applications embedded in the platform, such as resume-building tools and career-oriented modules.

### *4.4 Career Readiness and Employability Skills*

One of the most promising findings pertains to career readiness and employability skills, which were directly impacted by the practical elements of the platform. Students reported that the resume templates, career guidance modules, and project documentation tools helped them feel more prepared for the job market. This finding supports the notion that learning platforms should not only address academic outcomes but also facilitate career transition and professional development. The ability to create polished resumes [15]-[16], complete real-world projects, and engage with programming challenges helped students build a professional identity that extended beyond the classroom. This aligns with transformative learning theory (Mezirow, 2000), where learners engage in critical self-reflection that leads to shifts in personal and professional identity. By providing students with the tools to not only succeed in their academic work but also prepare for the workplace, LearnQuest demonstrates its potential as a platform that integrates academic learning with career-oriented skills.

### *4.5 Challenges and Areas for Improvement*

Despite these positive findings, some challenges emerged, particularly in the user interface and navigation of the platform. Students noted that while the content was rich and diverse, the initial learning curve associated with navigating the platform was steep. This indicates a need for further user experience (UX) refinement to ensure that the platform's complex features are easily accessible and intuitive, particularly for users who may not be as tech-savvy. The findings also revealed a preference for more collaborative learning opportunities, such as peer discussion forums or group-based projects. While the platform provided individual learning experiences, students expressed a desire for more opportunities to engage in social learning (Lave & Wenger, 1991), where they could share ideas, troubleshoot problems, and collaborate on projects. This insight suggests that incorporating collaborative elements could further enhance the social and cultural dimension of learning [5], deepening students' sense of community and engagement.

### *4.6 Implications for Educational Theory and Practice*

The findings from this study have significant implications for educational theory and practice, particularly in the context of engineering education. LearnQuest's integration of personalized learning, scaffolding, and career readiness features provides a model for how digital platforms can support both academic achievement and professional development. By emphasizing learner autonomy and offering customized learning paths, the platform aligns with the principles of constructivist and andragogical theories, making it a promising tool for higher education. Additionally, its success in fostering self-regulated learning and metacognitive skills suggests that digital learning environments can effectively support students in developing the skills necessary for both academic success and career readiness. At the same time, the study underscores the importance of user-centered design and the need for continuous feedback in ensuring that digital platforms meet the needs of diverse learners. As platforms like LearnQuest evolve, incorporating more collaborative and interactive elements will likely increase engagement, fostering a deeper sense of community and facilitating a more holistic learning experience these findings offer both a validation of the platform's educational effectiveness and a clear roadmap for future improvements, reinforcing the theoretical principles that underlie its design 4.7 The Role of Active Learning in Digital Education

### *4.7 Motivation and Learner Autonomy*

The strong usage patterns in the platform, particularly with regard to self-directed learning activities like quizzes and video lectures, are indicative of the platform's success in promoting learner autonomy, a key element in self-determination theory (Ryan & Deci, 2000). This theory postulates that motivation thrives when learners experience autonomy, competence, and relatedness. Data showing that students appreciated the flexibility in choosing learning materials based on personal interest or career goals supports this framework. Learners, empowered to control the pace and scope of their study, experienced a sense of ownership over their learning process. Moreover, the AI-driven chatbot serves as a prime example of providing competence support. As learners interact with the chatbot, they receive personalized feedback, which helps them track their progress and refine their skills.

### *4.8 Feedback and Formative Assessment: Fostering Self-Regulation*

Formative assessments on LearnQuest, including regular quizzes and project feedback, demonstrate significant contributions to self-regulated learning (Zimmerman, 1990). As students engage with assessments and receive feedback, they have the opportunity to assess their own understanding and make adjustments to their learning strategies. These findings support the notion that formative assessment, when integrated into the learning process, serves not only as an evaluation tool but also as a mechanism for reflection and adjustment, which is central to developing self-regulation. The continuous feedback loops present in LearnQuest allow students to engage in metacognitive activities where they assess their learning progress and identify areas for improvement. In the context of the feedback intervention theory (Hattie & Timperley, 2007), these cycles of feedback provide goal-relevant information that informs students of their progress toward learning goals, prompting necessary adjustments in their learning approach.

Career-Oriented Learning: The Bridge between Education and Employment One of the standout findings from the study is the platform's significant contribution to students' career readiness. Many students reported that they felt more confident in their job applications due to the inclusion of career-focused modules such as resume templates, professional skills development, and mock interviews. These features serve as an example of transformative learning (Mezirow, 2000), where students' perspective on the role of education in their lives is shifted to incorporate career preparation as a central goal. The integration of career-oriented learning aligns with the social cognitive career theory (Lent, Brown, & Hackett, 1994), which emphasizes the role of

self-efficacy and outcome expectations in shaping career decisions [9]-[10]. By providing tools that help students build professional documents (like resumes) and prepare for industry-related challenges (coding tasks, problem-solving activities), the platform helps students connect academic knowledge with their career aspirations, thus enhancing their career self-efficacy. Furthermore, the collaborative learning tools which might include group project features or peer-based discussions (should they be implemented) would further enrich the platform by simulating real-world work environments, where teamwork and collaboration are essential for success. This provides a situated learning experience, giving students hands-on preparation for future employment.

## 5. Discussion and Conclusion

The findings of this study provide valuable insights into the effectiveness of the LearnQuest platform in supporting engineering students' academic performance, career readiness, and self-regulated learning. When interpreted through well-established educational theories, the findings reveal that LearnQuest offers a promising model for integrating active learning, learner autonomy, career readiness, and feedback-driven support in a digital learning environment. This discussion will explore these findings in greater depth, relating them to key educational theories, highlighting the platform's strengths, and acknowledging areas for further improvement. Active Learning and Constructivist Principles a central finding of this study is the high engagement rates with LearnQuest's interactive learning materials, particularly in the areas of practical exercises and quizzes. This finding is consistent with constructivist theories (Piaget, 1976; Vygotsky, 1978), which emphasize the importance of active participation in the learning process. According to Piaget, learners actively construct their knowledge by engaging with and experimenting on the world around them. The platform's project-based tasks and coding challenges exemplify this process by requiring students to apply theoretical knowledge to real-world problems. Similarly, Vygotsky's Zone of Proximal Development (ZPD) highlights the importance of support in helping learners reach the next level of understanding [4]-[9]. The AI-driven chatbot in LearnQuest plays a pivotal role in this scaffolding process. By offering timely support and guidance, the chatbot ensures that students remain within their ZPD, providing cognitive support when they encounter challenges but allowing them to gradually move towards greater independence [18]-[20]. The findings also reflect Kolb's Experiential Learning Cycle (1984), where students move through a process of concrete experience, reflective observation, abstract conceptualization, and active experimentation. The combination of quizzes, project-based learning, and video lectures allows students to experience and reflect on engineering problems, conceptualize solutions, and experiment with different approaches to problem-solving. The platform thus supports deep, active learning in a manner consistent with these foundational learning theories.

Career Readiness: The career-oriented modules present in LearnQuest are a significant strength, aligning academic learning with practical, career-focused skills. Future iterations of such platforms should integrate more real-world tasks, industry simulations, and employer feedback mechanisms to enhance the employability of students. Feedback and Self-Regulation: Continuous feedback remains a critical component for student success. The study suggests that personalized, formative assessments and feedback loops not only support students' academic progress but also encourage metacognitive reflection, an essential element of self-regulated learning. Platforms should incorporate tools that track learning progress and offer real-time adaptive feedback, helping students to stay on track and make informed decisions about their learning. Collaborative Learning: Moving forward, collaborative learning features should be introduced to ensure that students engage with peers and experience the benefits of social learning. Implementing discussion forums, peer reviews, and group projects will enhance the platform's ability to replicate the social nature of traditional classrooms while fostering a sense of community. Final Thoughts LearnQuest presents a compelling example of how digital learning platforms can successfully integrate active learning, feedback-driven improvement, and career readiness in ways that support the cognitive, emotional, and professional growth of students. While challenges remain, such as the need for user interface refinement and the inclusion of collaborative learning tools, the platform provides an invaluable framework for future developments in digital education. Ultimately, LearnQuest has the potential to shape the future of engineering education, providing students with a dynamic and supportive learning environment that adapts to their needs, prepares them for the workforce, and equips them with the skills necessary to succeed in an ever-evolving global economy. By continuing to innovate and align with educational best practices, LearnQuest and similar platforms could revolutionize how engineering students learn and prepare for their careers in the digital age.

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